NAVFAC Naval Facilities Engineering Command
NAVFAC Southwest

Update on the Remedial Design for Parcel E-2

Hunters Point Naval Shipyard
BCT Meeting

June 5, 2014

Presentation Outline

- Review key comments received (through May 20, 2014) on the draft final RD package
  – Selection of historic earthquake records for seismic design
  – Conclusions from liquefaction potential analysis
  – Requirements for future work around existing landfill liner
  – Armor stone size for shoreline revetment design

- Review schedule for preparing final RD package

Selection of Historic Earthquake Records for Seismic Design

Synopsized Comment (EPA):

- Four "seed" acceleration time history records were selected for use in the seismic response analysis; however, the two earthquakes, Chi Chi Taiwan (1999) and Kocaeli Turkey (1999), do not represent strike-slip faults similar to the San Andreas (i.e., the fault geometry and displacement are different). Please clarify why these acceleration time history records are applicable to the San Andreas Fault given their vertical, rather than horizontal, motion.

Preliminary Navy Response:

- Appendix E was revised to better explain why these records are appropriate for predicting the seismic response at Parcel E-2.
  - The M 7.5 Kocaeli earthquake occurred on the North Anatolian fault, which is a right-lateral strike-slip fault with characteristics similar to the San Andreas fault.
  - The M 7.6 Chi Chi earthquake occurred on the Chelungpu thrust fault. Although a thrust fault is different from a strike-slip fault, such as the San Andreas fault, the magnitude and distance parameters of the M 7.6 Chi Chi earthquake closely matched the design conditions for Parcel E-2.

Selection of Historic Earthquake Records for Seismic Design (cont.)

Preliminary Navy Response (continued):

- The existing text in Appendix E states that a number of parameters were considered while selecting the seed acceleration time histories for the seismic response analysis, including magnitude, type of fault, component of motion, site-to-source distance, shear wave velocity, and peak ground acceleration. However, because of the limited database of world-wide recorded acceleration time histories for M 8.0 earthquakes, it was necessary to relax the criteria for matching some of these parameters.
- For earth structures, magnitude is the most important parameter in selecting the seed acceleration time histories because the magnitude is directly proportional to the duration of strong shaking. The seismically induced deformations of an earth structure are proportional to the square of the duration. For this reason, three acceleration time histories from the M 7.6 Chi Chi earthquake were used in the seismic response analysis for Parcel E-2 in addition to the record for the M 7.5 Kocaeli earthquake.
- In our opinion, the sense of fault deformation is not the most relevant parameter in selecting seed acceleration time histories. In addition, past earthquakes on the San Andreas fault show that there is generally a vertical offset that accompanies the horizontal offset.

Selection of Historic Earthquake Records for Seismic Design (cont.)

Preliminary Navy Response (continued):

- The design acceleration response spectrum was developed from attenuation equations for a M 8.0 earthquake on the San Andreas fault. The spectral matching (as described in Attachment E2) alters the frequency content of the recorded acceleration time history to match the design acceleration response spectrum. The differences in fault type are accounted for by the attenuation equations. Therefore, by altering the frequency content of the recorded motion we are confident that we are creating a spectrally matched motion that is representative of the design earthquake.
- As described in Attachment E2, the spectrally matched motions represent design conditions for the bedrock underlying Parcel E-2. These predicted bedrock motions are then used in the seismic response analysis (which is described in Section 7.2.3) to estimate motion of the ground surface at Parcel E-2.
- Section 3.2 was revised (consistent with text in Section 3.1) to explain that the seismic response analysis (1) “incorporates the impact of overburden soil on the PGA at the ground surface and average accelerations within slope stability trial surfaces” and (2) “incorporates the impact of shear wave velocity, modulus, and damping ratio of individual strata overlying the bedrock”.

Selection of Historic Earthquake Records for Seismic Design (cont.)

Synopsized Comment (City):

- We do not agree that earthquake magnitude is the most important factor in selecting and spectrally matching acceleration time histories. It is our opinion that using a vertical time history is not appropriate for this application (studying horizontal ground displacements). Many appropriate, large magnitude horizontal records are available at the PEER website that should be considered. We suggest the PS-10 recording from the Denali, M=7.9, be used.

Preliminary Navy Response:

- As described previously, magnitude is the most important parameter in selecting the seed acceleration time histories because the magnitude is directly proportional to the duration of strong shaking. The seismically induced deformations of an earth structure are proportional to the square of the duration.

- Also, as discussed previously, the frequency content of the motion was altered to match the design acceleration response spectrum for a M 8.0 earthquake on the San Andreas fault.

Selection of Historic Earthquake Records for Seismic Design (cont.)

Preliminary Navy Response (continued):

- The design evaluated four acceleration time histories, while the current state of practice for seismic design is to use three spectrally matched acceleration time histories.
  - Three acceleration time histories are horizontal components of motion (Stations TCU076 and TCU051 from the M 7.6 Chi Chi Taiwan earthquake, and Station Izmit from the M 7.5 Kocaeli Turkey earthquake)
  - One acceleration time history is a vertical component of motion (Station Chy029 from the M 7.6 Chi Chi Taiwan earthquake).
  - Accordingly, the seismic analyses used an adequate number of spectrally matched acceleration time histories for the Parcel E-2 design.

- However, to fully address the comment, the Navy performed the additional analyses using the Denali PS-10 acceleration time history records to demonstrate that the seismic design for Parcel E-2 is adequately conservative. The results are included in a new attachment to Appendix E.

Selection of Historic Earthquake Records for Seismic Design (cont.)

Preliminary Navy Response (continued):

- The results of the additional analyses show that the Denali PS-10 records result in less seismically induced permanent deformation than the four acceleration time histories used previously in the seismic analyses (including the Chi Chi and Kocaeli earthquakes). Accordingly, the results of the additional analyses demonstrate that the seismic design for Parcel E-2 is adequately conservative.

- The Navy chose to incorporate the additional information in a separate attachment because inclusion of the additional analyses in the main text of Appendix E would have required significant revisions that would not have any substantive effect on the technical conclusions.

Conclusions from Liquefaction Potential Analysis

Synopsized Comment (EPA):

- Appendix E indicates that lateral spreading is likely to be localized and "*therefore unlikely to be critical to the overall stability of the landfill, because only discrete zones are identified as potentially liquefiable.*" Please provide and/or reference information to substantiate that the lateral spreading is likely to be localized and unlikely to be critical to the overall stability of the landfill. Also, please discuss the impact of lateral spreading on the landfill liner.

Preliminary Navy Response:

- The six cross sections presented in Attachment E1 were revised to identify the approximate extent of potentially liquefiable soil layers (depicted with a hatched pattern). The potentially liquefiable soil layers were identified using CPT and SPT boring data as described in Appendix E.
- The revised cross sections show that the potentially liquefiable soil layers identified along the perimeter of the Parcel E-2 Landfill are primarily confined to the nearshore area but do not extend more than 150 feet inland. This information supports the statements in Appendix E (Section 4) that the potentially liquefiable soil layers are discontinuous and localized.

Conclusions from Liquefaction Potential Analysis (cont.)

Preliminary Navy Response (continued):

- Appendix E (Section 4.4) states that the presence of potentially liquefiable soil layers along the shoreline edge of the landfill prompted the Navy to identify an engineered solution (using geogrid reinforcement) and to perform quantitative slope stability analyses that account for potential liquefaction. The results of the post-liquefaction slope stability analyses are presented in Appendix E, Section 7.2.5.

- Based on the post-liquefaction slope stability analyses, the integrity of the final cover system (including the liner) would not be affected by potential lateral spreading resulting from localized liquefaction.

Requirements for Future Work Around Existing Landfill Liner

Synopsized Comment (EPA):

- The specifications (Section 31 00 00) were not revised to provide the basic procedures for performing earthwork, including waste consolidation activities, in the vicinity of the existing liner or the specific equipment that will be used for these activities.

Preliminary Navy Response:

- The specifications (Section 31 00 00) were revised to include a new subsection (under Part 3, Execution; Section 3.3, Protection) describing the procedures to protect the existing liner during construction.
  1. The RA contractor must delineate the extent of the existing liner prior to initiating earthwork.
  2. The RA contractor will restrict earthmoving activities on top of (and within two feet of) the existing liner, consistent with procedures that are already specified in Section 31 00 00 (specifically, Part 3, Section 3.6.1). These procedures require that the contractor use low ground pressure equipment when operating over the liner.
  3. The RA contractor will prepare a specific plan for the following activities that will require working in close proximity to the existing liner, including waste consolidation activities. The plan will specify the proposed equipment for performing these activities.

Armor Stone Size for Shoreline Revetment Design

Synopsized Comment (City):

- We request that the Navy reconsider the need for 450 pound rocks, which were specified to prevent theft. Based on information in a USACE publication (EM-1110-2-1601, “Engineering and Design - Hydraulic Design of Flood Control Channels”), any rock that is 80 pounds or larger will be a sufficient theft deterrent. We prefer that the rocks be much smaller than 450 pounds so that sediment accretion and revegetation, both natural and planned, might occur in the shoreline area.

Preliminary Navy Response:

- The design cited a different USACE publication (EM-1110-2-1614, “Design of Coastal Revetments, Seawalls and Bulkheads”), which indicates that armor stones between 400 and 500 are typically sufficient to withstand vandalism, theft, and inadvertent movement. The Navy believes that this is more appropriate than the guidance cited by the reviewer.
- The site conditions at Parcel E-2 require development of a robust shoreline protection approach to prevent potential exposure to hazardous substances, and any potential vandalism or theft of the armor stone could compromise the integrity of the remedy. In contrast, flood control channels may be able to accommodate a small amount of vandalism or theft while still serving their intended purpose.

Armor Stone Size for Shoreline Revetment Design (cont.)

Preliminary Navy Response (continued):

- In developing the shoreline revetment design for Parcel B, the Navy evaluated conditions at nearby India Basin Shoreline Park and observed areas where smaller armor rock (between 50 and 250 pounds) had been either stolen or moved, resulting in exposure of the underlying geosynthetic fabric. This observation reinforced the Navy's decision to specify a 450-pound median weight for the armor stone at Parcel B, consistent with 1985 USACE guidance for coastal revetments. The Navy used a similar rationale in developing the shoreline revetment design for Parcel E-2.
- Based on this information, the design was not revised to specify smaller armor stone for the shoreline revetment.

Missing armor stone at India Basin Shoreline Park

Armor Stone Size for Shoreline Revetment Design (cont.)

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Preliminary Navy Response (continued):

- Regarding the reviewer's statements about sediment accretion and revegetation, the Navy wishes to clarify that the establishment of aquatic vegetation along the shoreline revetment is not a requirement of the Navy's selected remedy.
- The slope of the Parcel E-2 revetment will be relatively steep (1V:3H), and any sediment accretion that occurs between the MSL and MHHW elevations would only extend over a relatively narrow width (less than 11 feet).
- The design was not revised to describe future revegetation along the shoreline revetment at Parcel E-2.

Current Schedule

- **Submit Draft RTCs for over-the-shoulder review:**
  July 1, 2014

- **Additional Meeting to discuss RTCs (if needed):**
  July 15, 2014

- **BCT/City Input Requested on RTCs (tentative):**
  July 22, 2014

- **Submit Final RD Package (tentative):**
  August 15, 2014